HHS Public Access

Author manuscript

Am Heart J. Author manuscript; available in PMC 2016 September 01.

Published in final edited form as:

Am Heart J. 2015 September ; 170(3): 447–454.e18. doi:10.1016/j.ahj.2015.06.004.

The design and implementation of a new surveillance system for venous thromboembolism using combined active and passive methods

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Abstract

Estimates of venous thromboembolism (VTE) incidence in the United States are limited by lack of a national surveillance system. We implemented a population-based surveillance system in Oklahoma County, OK, for April 1, 2012 to March 31, 2014, to estimate the incidences of first-time and recurrent VTE events, VTE-related mortality, and the proportion of case patients with provoked versus unprovoked VTE. The Commissioner of Health made VTE a reportable condition and delegated surveillance-related responsibilities to the University of Oklahoma, College of Public Health. The surveillance system included active and passive methods. Active surveillance involved reviewing imaging studies (such as chest computed tomography and compression ultrasounds) from all inpatient and outpatient facilities. Interrater agreement between surveillance officers collecting data was assessed using κ. Passive surveillance used *International Classification of Disease, Ninth Revision (ICD-9)* codes from hospital discharge data to identify cases. The sensitivity and specificity of various *ICD-9*–based case definitions will be assessed by comparison with cases identified through active surveillance. As of February 1, 2015, we screened 54,494 (99.5%) of the imaging studies and identified 2,725 case patients, of which 91.6% were from inpatient facilities, and 8.4% were from outpatient facilities. Agreement between surveillance officers was high ($\kappa \geq 0.61$ for 93.2% of variables). Agreement for the diagnosis of pulmonary embolism and diagnosis of deep vein thrombosis was $\kappa = 0.92$ (95% CI 0.74-1.00) and $\kappa = 0.89$ (95% CI 0.71-1.00), respectively. This surveillance system will provide data on the accuracy of *ICD-9*–based case definitions for surveillance of VTE events and help the Centers for Disease Control and Prevention develop a national VTE surveillance system.

The US Surgeon General's 2008 "Call to Action to Prevent Deep Vein Thrombosis (DVT) and Pulmonary Embolism (PE)"[1] raised the importance of conducting surveillance for venous thromboembolism (VTE). Current estimates of the burden of VTE in the United

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Disclosures

This project was funded by CDC funding: DD14-1407. Dr Bratzler would like to disclose a consultancy for CDC and Sanofi Pasteur. Dr Raskob would like to disclose a consultancy and honoraria for Bayer Healthcare, BMS, Boehringer Ingelheim, Daiichi Sankyo, Janssen Pharmaceuticals, Pfizer, and ISIS Pharmaceuticals. Dr Wendelboe would like to disclose an honoraria from Bristol-Myers Squibb. None of the other authors have any disclosures.

States (350,000-900,000 events and 100,000-300,000 deaths annually) come from 2 principal sources. The first is cohort studies in selected counties and then generalized to the US population.[2,3] The second is administrative claims data.[4-8] Both of these methods have limitations. The estimates from the cohort studies come from a largely white population and may not be representative of the diversity of the US population. Although the inclusion of present on admission (POA) codes has increased the positive predictive value of *International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9 CM)* codes to identify inpatient VTE cases,[6] there are remaining limitations in using administrative data to document cases of VTE because (1) coding may reflect old diagnoses that are no longer active diagnoses, (2) coding practices vary between facilities, (3) the inability of deidentified data to differentiate between incident and recurrent events and between incident events and duplicate events caused by patient transfers, (4) the inability to determine dates of diagnosis (traditionally based on facility discharge dates), (5) nonhospitalized patients and those who had sudden death from PE have usually not been included in these estimates, and (6) the ideal case definition using selected *ICD-9 CM* codes has not been established given the varying performance of VTE-related *ICD-9 CM* codes.

In addition to removing the uncertainty in the estimates of VTE incidence, other aspects of the epidemiology of VTE disease would also be informed by improved surveillance. For example, it is difficult to differentiate between provoked and unprovoked events. Although certain strong risk factors have been well established, such as surgery, hospitalization, and cancer, a large number of patients experience VTE in the absence of an identifiable risk factor (ie, unprovoked VTE). The racial and ethnic distribution of VTE events in the United States, for both provoked and unprovoked events, remains incompletely understood. In addition, contemporary data are needed on the utilization of appropriate prophylaxis against VTE in patients at risk and to document the proportion of VTE events, which may have been potentially preventable.

Venous thromboembolism is a condition well suited for surveillance using modern techniques and diagnostic imaging. Because a diagnosis of DVT or PE based solely on the evaluation of clinical signs has proven unreliable, imaging studies are required for accurate diagnosis.[9] Noninvasive and highly sensitive and specific diagnostic procedures, including computed tomography angiography (CTA) for PE and compression ultrasound (CUS) for DVT, are routinely used in clinical practice for the diagnosis of VTE. Thus, the College of Public Health at the University of Oklahoma Health Sciences Center, in collaboration with the Centers for Disease Control and Prevention (CDC), the Oklahoma State Department of Health, and the Oklahoma City–County Health Department, established a novel pilot population-based surveillance system for VTE events in Oklahoma County, OK, from April 1, 2012 to March 31, 2014. Oklahoma County was suitable for this pilot testing because of the strong similarity of its population demographics to the US national population. We describe this novel surveillance approach for VTE events using combined active and passive surveillance and discuss how these methods may inform the development of a national surveillance system as well as contribute to increased understanding of the burden of VTE disease.

Methods

Surveillance system objectives

The primary aims of our pilot surveillance system were to (1) develop and implement a population-based surveillance system for DVT and PE in Oklahoma County, OK, that includes both active and passive surveillance activities and which can accurately capture outpatient, inpatient, and death-related VTE events and distinguish first episode (incident) from recurrent VTE events; (2) estimate the annual incidence of first-episode VTE events and DVT and PE separately, (3) estimate the annual incidence of recurrent VTE events and of the components of DVT and PE, (4) estimate the 30-day, 90-day, and 6-month mortality associated with a diagnosis of VTE and the component events of DVT or PE; (5) describe the above VTE disease burden indicators by age, gender, and race/ethnicity, including the minority groups of American Indian, Black, Hispanic, and Asian; (6) collect data on risk factors associated with documented VTE events; and (7) identify hypotheses for future research to reduce the burden of VTE disease (see Table I).

Surveillance system and population

A key and unique feature of this surveillance system is the collaboration with the Oklahoma State Commissioner of Health, who established VTE diagnoses as reportable conditions for 2010 to 2015 and delegated to the College of Public Health the authority to conduct the surveillance (Oklahoma Statute §631-106B). The surveillance was conducted as an activity authorized by federal[10] and state statutes for protection of public health, and, therefore, institutional review board approval for access to the health information was not required. The surveillance was conducted in compliance with the requirements of the US Health Insurance Portability and Accountability Act.

Oklahoma County is representative of the US population by race and ethnicity (Table II), although it has a higher percentage of American Indians (7.7% vs 1.7%).[11] In addition, it is an urban metropolitan service area in the center of the state for which few residents travel out of the county or the state for their health care. Hospital discharge data (described in detail below) for the state were accessed to determine that 98 Oklahoma County residents received care for a VTE-related event out of Oklahoma County during 2010 to 2012.

We implemented both active and passive surveillance methods in an effort to quantify and measure the extent to which each approach successfully identified cases. The active surveillance system was designed to serve as the criterion standard and to optimize specificity. The passive surveillance system was designed to optimize sensitivity. The Figure is a flowchart of all surveillance activities.

Active surveillance

Active surveillance consisted of surveillance officers (graduate students in public health generally with clinical backgrounds) visiting all of the 13 inpatient facilities and all of the eligible outpatient facilities in Oklahoma County on a regular basis. Criteria for eligible inpatient and outpatient facilities are summarized in Table III. Surveillance officers reviewed the text of relevant imaging reports from April 1, 2012 to March 31, 2014, to

classify VTE cases as definite or probable cases or noncases (see case definition, Table IV). We also included the Oklahoma City Veterans Affairs (VA) Medical Center. Eligible facilities were identified by using 3 different data sources: (1) historic hospital discharge data (2009-2010) to estimate the potential caseload; (2) the Oklahoma State Health Department's database of facilities licensed for CTA, magnetic resonance imaging (MRI), and CUS equipment in the county; and 3) the national accrediting body of facilities using those same diagnostic equipment. Before initiating surveillance, we met with the Greater Oklahoma City Hospital Council and introduced the surveillance project to the chief executive officers of the county's hospitals. We also communicated with each inpatient and outpatient facility by mail and telephone. We met with the health information management director of each facility to establish surveillance activities, provide them with the case definition, and tailor our case methods to their facility processes. We screened outpatient facilities for eligibility based on the relevant diagnostic equipment they used and whether they diagnosed patients with VTE conditions.

Each facility (both inpatient and outpatient) generated lists of all patients who had received one of the qualifying imaging studies (irrespective of the radiologists' diagnosis) or a diagnostic or procedure code (online Appendix A and B) during the surveillance period, regardless of the patient's symptoms. Because of varying medical records systems, facilities used a variety of methods to identify these patients, including querying their system for *ICD-9 CM* procedure codes, current procedural terminology (CPT) codes, and free text for the test (such as "CTA" or "ultrasound"). We worked with a variety of electronic medical records systems, including Cerner, Centricity, Meditech (Horizon Patient Folder), and EPIC as well as a few facilities still using paper-based records.

Patient records were retrieved by facility staff and reviewed by surveillance officers to identify those whose residence was within Oklahoma County (as determined by county and ZIP code information) for inclusion in the surveillance. Subsequently, the surveillance officers determined eligibility based on the occurrence of a VTE event during the surveillance period (April 1, 2012 to March 31, 2014), which was followed by review of the final impression from the imaging report and complete data abstraction of eligible cases. Screening the imaging report for a PE or DVT diagnosis required approximately 1 minute per record, and data abstraction typically required 45 to 60 minutes per record. Data abstraction included patient-identifying information, demographic variables, medical history (including history of VTE), signs and symptoms related to their VTE diagnosis, major and minor risk factors, and VTE prophylaxis and treatment, including medication regimens and dates administered.

We collected data on age, gender, race (defined as white, black, American Indian, Asian, Pacific Islander, and other) and ethnicity (defined as Hispanic and non-Hispanic), obesity (measured by height and weight), hospitalization, surgery or trauma within the prior 12 months, cancer (except basal or squamous cell carcinoma of the skin), paralysis of the leg, pregnancy, myocardial infarction, stroke, systemic lupus erythematosus, and inflammatory bowel disease. Reason for hospitalization and indication for and type of surgery were also collected. Dates for each risk factor were collected when available, and, when unavailable,

any data regarding time frame were collected and categorized into <3 months, 3 to 5.9 months, 6 to 11.9 months, and ≥12 months.

Surveillance officers entered case-patient data directly into Velos eResearch using encrypted laptops with secure internet connections. The Velos-based database was housed behind the university's information technology firewall, and the case-patient data were securely stored and compliant with the Health Insurance Portability and Accountability Act regulations. We limited the use of paper-based records to increase security as well as efficiency of data entry.

Passive surveillance

Passive surveillance consisted of acquiring all-payer hospital discharge data (with patient-identifying information) from the Oklahoma State Department of Health's Division of Health Care Information. Because the VA is not required to report to state agencies, their data are not included in the hospital discharge data. The *ICD-9 CM* codes used in this system are listed in the online Appendix A and B. We were able to access and use patient-specific data because the State Health Commissioner delegated to the College of Public Health the authority to conduct the surveillance (Oklahoma Statute §631-106B).

We obtained hospital discharge data with patient identifiers from all inpatient, outpatient, and ambulatory surgery center facilities for all cases diagnosed and treated in Oklahoma County and all events associated with that individual for each year 2010 to 2012 using our broad VTE definition (online Appendix A and B) (2013-2014 data will be obtained when available). Cases were identified by using either the primary *ICD-9 CM* diagnosis field or any of the 15 contributing *ICD-9 CM* diagnosis fields.

We also received the January 1, 2010 to April 30, 2014, mortality files compiled from death certificates (subsequent years will be obtained upon availability). Cases were identified using *ICD-10* codes and text in the cause of death and significant contributing causes of death fields (online Appendix A and B).

The data were merged and deduplicated within and across years, between discharge types (ie, inpatient, outpatient, and ambulatory surgical care), and across data types (ie, hospital discharge data and mortality data) using Link Plus,[12] a probabilistic record linkage software designed to link records with incomplete or variable information according to patient-identifying information (name, date of birth, address, and social security number). The probabilistic linkage algorithm assigns probability scores that indicate how likely it is that a pair of records refer to the same person. A threshold score of 3 was used to automatically accept and reject potential links with all uncertain pairs manually reviewed by 2 independent reviewers. Once complete, 2 manual reviews were compared to confirm or reject matches.

Case definition

We used tiered case definitions and case finding methods based on the amount and quality of the diagnostic data available as shown in Table IV. All DVT events of the upper and lower extremities are included, including acute, chronic, and recurrent. Superficial venous thromboses were excluded. For active surveillance, a finding of DVT or PE based on an imaging study including CTA, CUS, MRI, ventilation-perfusion (V/Q) scan, or pulmonary

angiogram was required for either a definite or probable case. Final case classification was assigned by study investigators (see interrater reliability below). Furthermore, patients were classified as a probable case when the death certificate listed PE as a primary or contributing cause of death.

Passive surveillance relied on *ICD-9 CM* (diagnosis and procedure), CPT, or POA codes for identification of possible VTE events. Thus, the only case classification available was as a possible case (in which ≥2 qualifying codes were required). The full case definition is included in the appendix.

Comparing active with passive surveillance

Once available, the passive surveillance data (ie, hospital discharge data and mortality data) will be linked to the active data and deduplicated using probabilistic record linkage methods similar to those described in the passive surveillance above. In addition, we will use the same method to link live cases identified using active surveillance to the mortality file.

Statistical methods

Descriptive statistics were used to summarize population demographics. The distribution of case patients for each stage of surveillance and disease manifestation was presented for each facility type (inpatient vs outpatient). All analyses were conducted using SAS 9.3 (SAS Institute, Inc, Cary, NC).

Interrater reliability for data collection was evaluated by taking a random sample of 5% (with a minimum of 5 records per facility) of the cases that were identified from 7 inpatient facilities and selected for quality assurance. At least 2 secondary surveillance officers independently collected data for each identified case, and agreement was assessed (using the κ statistic) between the primary surveillance officer and the 2 secondary reviewers.

We used the free marginal method[13] to calculate κ to assess agreement for all categorical variables. Agreement was categorized into very good (κ = 0.81-1.0), good (κ = 0.61-0.80), moderate (κ = 0.41-0.60), and poor to fair ($\kappa \leq 0.40$).

Funding was provided through a cooperative agreement (DD14-1407) with the CDC for the design and implementation of the surveillance system and publication of the design manuscript. The authors are solely responsible for the design and conduct of this study; all study analyses, the drafting and editing of the paper, and its final contents.

Results

All 13 inpatient facilities in Oklahoma County and the Oklahoma City VA Medical Center were included in this surveillance system. Fifty-six outpatient facilities were identified as being potentially eligible for surveillance; however, after contacting each facility, only 8 facilities met the criteria to be included in the surveillance, each of which contributed data to the surveillance system. As of February 1, 2015, we have screened 54,494 (99.5%) of 54,782 identified imaging records of patients having had one of the diagnostic procedures (ie, CTA, MRI, V/Q scan, and CUS) during the surveillance period (Table V). From the

records screened, we have identified 2,725 case patients with VTE using the active surveillance system (of which 2,496 [91.6%] case patients are from inpatient facilities and 229 [8.4%] case patients are from outpatient facilities). Among the 2,231 case patients for whom data collection is complete, 1,290 (63%) have DVT, 476 (23%) have PE, and 293 (14%) have both DVT and PE. In addition, among the 172 (7.7%) case patients enrolled from outpatient facilities for whom data collection has been completed, 156 (91%) case patients have DVT, 11 (6%) case patients have PE, and 5 (3%) case patients have both DVT and PE (Table VI). Using hospital discharge data for 2010 to 2012, we identified 98 residents (2.4% of the case patients) of Oklahoma County who received a diagnosis for a VTE-related event outside Oklahoma County who were missed by the active surveillance.

Our data collection instrument had 44 variables. Agreement between data collectors was high, with 41 (93.2%) variables having κ, ≥0.61. The agreement for our 2 key measurements, diagnosis of PE and diagnosis of DVT, were $\kappa = 0.92$ (95% CI 0.74-1.00) and $\kappa = 0.89$ (95% CI 0.71-1.00), respectively. The 3 variables with moderate agreement were symptoms of the leg ($\kappa = 0.59$; 95% CI 0.42-0.77), history of DVT ($\kappa = 0.59$; 95% CI 0.42-0.77), and history of hospitalization ($\kappa = 0.45$; 95% CI 0.27-0.62). The agreement between the 2 study investigators' classification of cases according to the case definition was also high, DVT, $\kappa = 0.84$ (95% CI 0.76-0.93) and PE, $\kappa = 0.94$ (95% CI 0.88-1.00).

Discussion

We established a pilot population-based surveillance system for VTE using both active and passive methods in Oklahoma County, OK, to inform CDC regarding the development of future national VTE surveillance. We designed this system to (1) improve VTE-related estimates of the incidence of first-time and recurrent events and mortality rates, (2) differentiate between provoked and unprovoked events as well as describe these patients by demographic characteristics (including race/ethnicity), and (3) identify the contribution of patients with VTE events in the outpatient setting.

This surveillance system has been operating as intended as evidenced by the progress made in identifying potential case patients, applying the case definition, and collecting the demographic and diagnostic information regarding the VTE event. Among the 54,670 patients flagged for screening based on having a diagnostic procedure during the surveillance period, 99.6% have been screened. In addition, data have been collected for >80% of all identified cases. This amount of progress lends confidence to the continued success of the surveillance system through the end of the surveillance period.

This pilot surveillance system was not designed to be sustainable in its present form. Instead, we designed it to inform us and CDC regarding the performance of each aspect of VTE disease surveillance. However, without a standard by which to assess the performance of hospital discharge and administrative claims data, the sensitivity and specificity of a national surveillance system will be unknown. Hence, the active surveillance was developed to serve as the criterion standard by maximizing specificity through the use of imaging studies to confirm and classify cases. On the other hand, because *ICD-9 CM* codes have the tendency to "follow" patients over time, querying the hospital discharge database is a highly

sensitive technique for identifying possible cases. Sensitivity was further enhanced by using a broad set of codes designed to maximize the identification of possible cases. The final step of linking the active and passive surveillance databases by patient-identifying information and then investigating the discordant cases will allow us to assess the performance (ie, sensitivity, specificity, and positive predictive values) of case definitions based on *ICD-9 CM* codes. We will also be able to evaluate the ability of our active system to detect cases by sampling those possible cases from the hospital discharge data who did not link to the active cases and following up back to determine if they were a true case missed by our active methods or a false-positive based on using *ICD-9 CM* codes. Using the cleaned, deduplicated, linked database, we will be able to provide estimates of first-time and recurrent VTE events that are likely more accurate than any that are currently available by claims data.

Another strength of this system will be the ability to better describe risk factors for VTE events and to differentiate between provoked and unprovoked events. Among the case patients with provoked VTE events, we will be able to measure the utilization of VTE prevention measures and identify points of intervention to improve the implementation of prevention if needed. This may improve our ability to identify a certain proportion of potentially preventable cases (which could be used as a performance metric for hospitals in the future). Finally, given the racially diverse population in Oklahoma County, we aim to be able to describe the incidence and risk factors in minority populations that have been historically understudied.

The last objective of our surveillance system is to determine the number of patients with VTE events being diagnosed and/or managed in an outpatient setting. The barriers to outpatient management of VTE in the United States include (1) initial treatment has traditionally consisted of parenteral therapy, which is easier to administer in the hospital,[14] (2) remuneration for health care facilities and providers is higher in an inpatient setting,[15,16] and (3) the patient population often has comorbid conditions requiring inpatient care. On the other hand, a factor which may increase the outpatient management of VTE is the development of new oral medications.[14,17] Our finding that approximately 8% of patients were diagnosed in the outpatient setting is lower but similar to 11% in a German retrospective cohort study. [18] By conducting active surveillance in outpatient facilities with CT and CUS machines, we will be able to better understand the proportion of patients referred to tertiary care facilities for further treatment and care and thus inform future scaled-up national surveillance regarding the importance of including outpatient facilities.

Our surveillance system is subject to certain limitations. One limitation is the time lag between the hospitalization and when the hospital discharge data are available for the passive surveillance. Specifically, the hospital discharge data are not available until approximately 1 year after the end of that discharge year. In contrast, the active data are typically delayed by no more than a month (while waiting for the patient to be discharged and all the data to be entered into the facility's electronic medical record). Thus, the data collected by active and passive methods cannot be linked and analyzed until ≥1 year after the event. Other limitations include the cost involved to conduct active surveillance (which is unlikely to be maintained over long periods), missing risk factor information in the

medical record, variability in the way facilities identify potentially eligible patients for screening, and the amount of time required for surveillance officers to screen potentially eligible patients and subsequently enter their information into the database.

Additional limitations include factors contributing to us potentially missing a VTE case. One scenario is those patients who seek and are diagnosed outside the catchment area (ie, Oklahoma County). We will, however, include these cases if they receive follow-up care within the catchment area during the surveillance window. Another scenario is those VTE cases that never had the relevant imaging studies, did not have an eligible *ICD-9* code, and, for those who died, had no mention on the death certificate. Finally, although the demographics of Oklahoma County are remarkably similar to the US national population, there may be other features of our surveillance population, which may not be generalizable to the US population. This latter limitation is the key reason why a national surveillance system is required. Although incidence estimates derived from a population-based study restricted to a county or state may have limitations in generalizability, the methods evaluated in the pilot study should be scalable for use in a broader national effort.

Conclusions

In conclusion, we developed a pilot population-based surveillance system for VTE in Oklahoma County, OK. This novel system incorporates both active and passive elements. The most important factor in conducting our surveillance was the collaboration with CDC and the Oklahoma Commissioner of Health. This allowed us to work with all facilities in the county and collect the required information. We are in the process of better understanding the quality of individual *ICD-9 CM* codes in identifying true cases. In addition, these results will help inform future national surveillance and monitoring for VTE events. Future topics we plan to address using these data include identifying the proportion of preventable VTE events, better elucidating the incidence of provoked versus unprovoked events, and describing the extent to which patients receive the evidence-based recommended treatment for their VTE condition.

Acknowledgments

This surveillance system was funded by a cooperative agreement with the CDC DD14-1407. We are also deeply grateful for the work of the surveillance officer, Natalie Feland, Aubrey Balch, Jannate Ahmed, Evaren Page, and Ashley Sword-Buster, for their tireless dedication in collecting the data. We are also grateful for Pravina Kota for her information technology support, including the development of the database.

CDC disclaimer: The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the CDC.

Appendix A

Deep vein thrombosis—related *ICD-9* codes, CPT codes, and *ICD-10* codes

***ICD-10* codes**	**Definition**
I80	Phlebitis and thrombophlebitis

ICD-10 codes	Definition
I800	Phlebitis and thrombophlebitis of superficial vessels of lower extremities
I8000	Phlebitis and thrombophlebitis of superficial vessels of unspecified lower extremity
I8001	Phlebitis and thrombophlebitis of superficial vessels of right lower extremity
I8002	Phlebitis and thrombophlebitis of superficial vessels of left lower extremity
I8003	Phlebitis and thrombophlebitis of superficial vessels of lower extremities, bilateral
I801	Phlebitis and thrombophlebitis of femoral vein
I8010	Phlebitis and thrombophlebitis of unspecified femoral vein
I8011	Phlebitis and thrombophlebitis of right femoral vein
I8012	Phlebitis and thrombophlebitis of left femoral vein
I8013	Phlebitis and thrombophlebitis of femoral vein, bilateral
I802	Phlebitis and thrombophlebitis of other and unspecified deep vessels of lower extremities
I8020	Phlebitis and thrombophlebitis of unspecified deep vessels of lower extremities
I80201	Phlebitis and thrombophlebitis of unspecified deep vessels of right lower extremity
I80202	Phlebitis and thrombophlebitis of unspecified deep vessels of left lower extremity
I80203	Phlebitis and thrombophlebitis of unspecified deep vessels of lower extremities, bilateral
I80209	Phlebitis and thrombophlebitis of unspecified deep vessels of unspecified lower extremity
I8021	Phlebitis and thrombophlebitis of iliac vein
I80211	Phlebitis and thrombophlebitis of right iliac vein
I80212	Phlebitis and thrombophlebitis of left iliac vein
I80213	Phlebitis and thrombophlebitis of iliac vein, bilateral
I80219	Phlebitis and thrombophlebitis of unspecified iliac vein
I8022	Phlebitis and thrombophlebitis of popliteal vein
I80221	Phlebitis and thrombophlebitis of right popliteal vein
I80222	Phlebitis and thrombophlebitis of left popliteal vein
I80223	Phlebitis and thrombophlebitis of popliteal vein, bilateral
I80229	Phlebitis and thrombophlebitis of unspecified popliteal vein
I8023	Phlebitis and thrombophlebitis of tibial vein
I80231	Phlebitis and thrombophlebitis of right tibial vein
I80232	Phlebitis and thrombophlebitis of left tibial vein
I80233	Phlebitis and thrombophlebitis of tibial vein, bilateral
I80239	Phlebitis and thrombophlebitis of unspecified tibial vein
I8029	Phlebitis and thrombophlebitis of other deep vessels of lower extremities
I80291	Phlebitis and thrombophlebitis of other deep vessels of right lower extremity
I80292	Phlebitis and thrombophlebitis of other deep vessels of left lower extremity

ICD-10 codes	Definition
I80293	Phlebitis and thrombophlebitis of other deep vessels of lower extremity, bilateral
I80299	Phlebitis and thrombophlebitis of other deep vessels of unspecified lower extremity
I803	Phlebitis and thrombophlebitis of lower extremities, unspecified
I808	Phlebitis and thrombophlebitis of other sites
I809	Phlebitis and thrombophlebitis of unspecified site
I82	Other venous embolism and thrombosis
I821	Thrombophlebitis migrans
I822	Embolism and thrombosis of vena cava and other thoracic veins
I8221	Embolism and thrombosis of superior vena cava
I82210	Acute embolism and thrombosis of superior vena cava
I82211	Chronic embolism and thrombosis of superior vena cava
I8222	Embolism and thrombosis of inferior vena cava
I82220	Acute embolism and thrombosis of inferior vena cava
I82221	Chronic embolism and thrombosis of inferior vena cava
I8229	Embolism and thrombosis of other thoracic veins
I82290	Acute embolism and thrombosis of other thoracic veins
I82291	Chronic embolism and thrombosis of other thoracic veins
I823	Embolism and thrombosis of renal vein
I824	Acute embolism and thrombosis of deep veins of lower extremity
I8240	Acute embolism and thrombosis of unspecified deep veins of lower extremity
I82401	Acute embolism and thrombosis of unspecified deep veins of right lower extremity
I82402	Acute embolism and thrombosis of unspecified deep veins of left lower extremity
I82403	Acute embolism and thrombosis of unspecified deep veins of lower extremity, bilateral
I82409	Acute embolism and thrombosis of unspecified deep veins of unspecified lower extremity
I8241	Acute embolism and thrombosis of femoral vein
I82411	Acute embolism and thrombosis of right femoral vein
I82412	Acute embolism and thrombosis of left femoral vein
I82413	Acute embolism and thrombosis of femoral vein, bilateral
I82419	Acute embolism and thrombosis of unspecified femoral vein
I8242	Acute embolism and thrombosis of iliac vein
I82421	Acute embolism and thrombosis of right iliac vein
I82422	Acute embolism and thrombosis of left iliac vein
I82423	Acute embolism and thrombosis of iliac vein, bilateral
I82429	Acute embolism and thrombosis of unspecified iliac vein
I8243	Acute embolism and thrombosis of popliteal vein
I82431	Acute embolism and thrombosis of right popliteal vein
I82432	Acute embolism and thrombosis of left popliteal vein
I82433	Acute embolism and thrombosis of popliteal vein, bilateral

ICD-10 codes	Definition
I82439	Acute embolism and thrombosis of unspecified popliteal vein
I8244	Acute embolism and thrombosis of tibial vein
I82441	Acute embolism and thrombosis of right tibial vein
I82442	Acute embolism and thrombosis of left tibial vein
I82443	Acute embolism and thrombosis of tibial vein, bilateral
I82449	Acute embolism and thrombosis of unspecified tibial vein
I8249	Acute embolism and thrombosis of other specified deep vein of lower extremity
I82491	Acute embolism and thrombosis of other specified deep vein of right lower extremity
I82492	Acute embolism and thrombosis of other specified deep vein of left lower extremity
I82493	Acute embolism and thrombosis of other specified deep vein of lower extremity, bilateral
I82499	Acute embolism and thrombosis of other specified deep vein of unspecified lower extremity
I824Y	Acute embolism and thrombosis of unspecified deep veins of proximal lower extremity
I824Y1	Acute embolism and thrombosis of unspecified deep veins of right proximal lower extremity
I824Y2	Acute embolism and thrombosis of unspecified deep veins of left proximal lower extremity
I824Y3	Acute embolism and thrombosis of unspecified deep veins of proximal lower extremity, bilateral
I824Y9	Acute embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity
I824Z	Acute embolism and thrombosis of unspecified deep veins of distal lower extremity
I824Z1	Acute embolism and thrombosis of unspecified deep veins of right distal lower extremity
I824Z2	Acute embolism and thrombosis of unspecified deep veins of left distal lower extremity
I824Z3	Acute embolism and thrombosis of unspecified deep veins of distal lower extremity, bilateral
I824Z9	Acute embolism and thrombosis of unspecified deep veins of unspecified distal lower extremity
I825	Chronic embolism and thrombosis of deep veins of lower extremity
I8250	Chronic embolism and thrombosis of unspecified deep veins of lower extremity
I82501	Chronic embolism and thrombosis of unspecified deep veins of right lower extremity
I82502	Chronic embolism and thrombosis of unspecified deep veins of left lower extremity
I82503	Chronic embolism and thrombosis of unspecified deep veins of lower extremity, bilateral
I82509	Chronic embolism and thrombosis of unspecified deep veins of unspecified lower extremity
I8251	Chronic embolism and thrombosis of femoral vein
I82511	Chronic embolism and thrombosis of right femoral vein
I82512	Chronic embolism and thrombosis of left femoral vein

ICD-10 codes	Definition
I82513	Chronic embolism and thrombosis of femoral vein, bilateral
I82519	Chronic embolism and thrombosis of unspecified femoral vein
I8252	Chronic embolism and thrombosis of iliac vein
I82521	Chronic embolism and thrombosis of right iliac vein
I82522	Chronic embolism and thrombosis of left iliac vein
I82523	Chronic embolism and thrombosis of iliac vein, bilateral
I82529	Chronic embolism and thrombosis of unspecified iliac vein
I8253	Chronic embolism and thrombosis of popliteal vein
I82531	Chronic embolism and thrombosis of right popliteal vein
I82532	Chronic embolism and thrombosis of left popliteal vein
I82533	Chronic embolism and thrombosis of popliteal vein, bilateral
I82539	Chronic embolism and thrombosis of unspecified popliteal vein
I8254	Chronic embolism and thrombosis of tibial vein
I82541	Chronic embolism and thrombosis of right tibial vein
I82542	Chronic embolism and thrombosis of left tibial vein
I82543	Chronic embolism and thrombosis of tibial vein, bilateral
I82549	Chronic embolism and thrombosis of unspecified tibial vein
I8259	Chronic embolism and thrombosis of other specified deep vein of lower extremity
I82591	Chronic embolism and thrombosis of other specified deep vein of right lower extremity
I82592	Chronic embolism and thrombosis of other specified deep vein of left lower extremity
I82593	Chronic embolism and thrombosis of other specified deep vein of lower extremity, bilateral
I82599	Chronic embolism and thrombosis of other specified deep vein of unspecified lower extremity
I825Y	Chronic embolism and thrombosis of unspecified deep veins of proximal lower extremity
I825Y1	Chronic embolism and thrombosis of unspecified deep veins of right proximal lower extremity
I825Y2	Chronic embolism and thrombosis of unspecified deep veins of left proximal lower extremity
I825Y3	Chronic embolism and thrombosis of unspecified deep veins of proximal lower extremity, bilateral
I825Y9	Chronic embolism and thrombosis of unspecified deep veins of unspecified proximal lower extremity
I825Z	Chronic embolism and thrombosis of unspecified deep veins of distal lower extremity
I825Z1	Chronic embolism and thrombosis of unspecified deep veins of right distal lower extremity
I825Z2	Chronic embolism and thrombosis of unspecified deep veins of left distal lower extremity
I825Z3	Chronic embolism and thrombosis of unspecified deep veins of distal lower extremity, bilateral
I825Z9	Chronic embolism and thrombosis of unspecified deep veins of unspecified distal lower extremity

ICD-10 codes	Definition
I826	Acute embolism and thrombosis of veins of upper extremity
I8260	Acute embolism and thrombosis of unspecified veins of upper extremity
I82601	Acute embolism and thrombosis of unspecified veins of right upper extremity
I82602	Acute embolism and thrombosis of unspecified veins of left upper extremity
I82603	Acute embolism and thrombosis of unspecified veins of upper extremity, bilateral
I82609	Acute embolism and thrombosis of unspecified veins of unspecified upper extremity
I8261	Acute embolism and thrombosis of superficial veins of upper extremity
I82611	Acute embolism and thrombosis of superficial veins of right upper extremity
I82612	Acute embolism and thrombosis of superficial veins of left upper extremity
I82613	Acute embolism and thrombosis of superficial veins of upper extremity, bilateral
I82619	Acute embolism and thrombosis of superficial veins of unspecified upper extremity
I8262	Acute embolism and thrombosis of deep veins of upper extremity
I82621	Acute embolism and thrombosis of deep veins of right upper extremity
I82622	Acute embolism and thrombosis of deep veins of left upper extremity
I82623	Acute embolism and thrombosis of deep veins of upper extremity, bilateral
I82629	Acute embolism and thrombosis of deep veins of unspecified upper extremity
I827	Chronic embolism and thrombosis of veins of upper extremity
I8270	Chronic embolism and thrombosis of unspecified veins of upper extremity
I82701	Chronic embolism and thrombosis of unspecified veins of right upper extremity
I82702	Chronic embolism and thrombosis of unspecified veins of left upper extremity
I82703	Chronic embolism and thrombosis of unspecified veins of upper extremity, bilateral
I82709	Chronic embolism and thrombosis of unspecified veins of unspecified upper extremity
I8271	Chronic embolism and thrombosis of superficial veins of upper extremity
I82711	Chronic embolism and thrombosis of superficial veins of right upper extremity
I82712	Chronic embolism and thrombosis of superficial veins of left upper extremity
I82713	Chronic embolism and thrombosis of superficial veins of upper extremity, bilateral
I82719	Chronic embolism and thrombosis of superficial veins of unspecified upper extremity

ICD-10 codes	Definition
I8272	Chronic embolism and thrombosis of deep veins of upper extremity
I82721	Chronic embolism and thrombosis of deep veins of right upper extremity
I82722	Chronic embolism and thrombosis of deep veins of left upper extremity
I82723	Chronic embolism and thrombosis of deep veins of upper extremity, bilateral
I82729	Chronic embolism and thrombosis of deep veins of unspecified upper extremity
I82A	Embolism and thrombosis of axillary vein
I82A1	Acute embolism and thrombosis of axillary vein
I82A11	Acute embolism and thrombosis of right axillary vein
I82A12	Acute embolism and thrombosis of left axillary vein
I82A13	Acute embolism and thrombosis of axillary vein, bilateral
I82A19	Acute embolism and thrombosis of unspecified axillary vein
I82A2	Chronic embolism and thrombosis of axillary vein
I82A21	Chronic embolism and thrombosis of right axillary vein
I82A22	Chronic embolism and thrombosis of left axillary vein
I82A23	Chronic embolism and thrombosis of axillary vein, bilateral
I82A29	Chronic embolism and thrombosis of unspecified axillary vein
I82B	Embolism and thrombosis of subclavian vein
I82B1	Acute embolism and thrombosis of subclavian vein
I82B11	Acute embolism and thrombosis of right subclavian vein
I82B12	Acute embolism and thrombosis of left subclavian vein
I82B13	Acute embolism and thrombosis of subclavian vein, bilateral
I82B19	Acute embolism and thrombosis of unspecified subclavian vein
I82B2	Chronic embolism and thrombosis of subclavian vein
I82B21	Chronic embolism and thrombosis of right subclavian vein
I82B22	Chronic embolism and thrombosis of left subclavian vein
I82B23	Chronic embolism and thrombosis of subclavian vein, bilateral
I82B29	Chronic embolism and thrombosis of unspecified subclavian vein
I82C	Embolism and thrombosis of internal jugular vein
I82C1	Acute embolism and thrombosis of internal jugular vein
I82C11	Acute embolism and thrombosis of right internal jugular vein
I82C12	Acute embolism and thrombosis of left internal jugular vein
I82C13	Acute embolism and thrombosis of internal jugular vein, bilateral
I82C19	Acute embolism and thrombosis of unspecified internal jugular vein
I82C2	Chronic embolism and thrombosis of internal jugular vein
I82C21	Chronic embolism and thrombosis of right internal jugular vein
I82C22	Chronic embolism and thrombosis of left internal jugular vein

ICD-10 codes	Definition
I82C23	Chronic embolism and thrombosis of internal jugular vein, bilateral
I82C29	Chronic embolism and thrombosis of unspecified internal jugular vein
I828	Embolism and thrombosis of other specified veins
I8281	Embolism and thrombosis of superficial veins of lower extremities
I82811	Embolism and thrombosis of superficial veins of right lower extremities
I82812	Embolism and thrombosis of superficial veins of left lower extremities
I82813	Embolism and thrombosis of superficial veins of lower extremities, bilateral
I82819	Embolism and thrombosis of superficial veins of unspecified lower extremities
I8289	Embolism and thrombosis of other specified veins
I82890	Acute embolism and thrombosis of other specified veins
I82891	Chronic embolism and thrombosis of other specified veins
I829	Embolism and thrombosis of unspecified vein
I8290	Acute embolism and thrombosis of unspecified vein
I8291	Chronic embolism and thrombosis of unspecified vein
I870	Postthrombotic syndrome
I8700	Postthrombotic syndrome without complications
I87001	Postthrombotic syndrome without complications of right lower extremity
I87002	Postthrombotic syndrome without complications of left lower extremity
I87003	Postthrombotic syndrome without complications of bilateral lower extremity
I87009	Postthrombotic syndrome without complications of unspecified extremity
I8701	Postthrombotic syndrome with ulcer
I87011	Postthrombotic syndrome with ulcer of right lower extremity
I87012	Postthrombotic syndrome with ulcer of left lower extremity
I87013	Postthrombotic syndrome with ulcer of bilateral lower extremity
I87019	Postthrombotic syndrome with ulcer of unspecified lower extremity
I8702	Postthrombotic syndrome with inflammation
I87021	Postthrombotic syndrome with inflammation of right lower extremity
I87022	Postthrombotic syndrome with inflammation of left lower extremity
I87023	Postthrombotic syndrome with inflammation of bilateral lower extremity
I87029	Postthrombotic syndrome with inflammation of unspecified lower extremity
I8703	Postthrombotic syndrome with ulcer and inflammation
I87031	Postthrombotic syndrome with ulcer and inflammation of right lower extremity

ICD-10 codes	Definition
I87032	Postthrombotic syndrome with ulcer and inflammation of left lower extremity
I87033	Postthrombotic syndrome with ulcer and inflammation of bilateral lower extremity
I87039	Postthrombotic syndrome with ulcer and inflammation of unspecified lower extremity
I8709	Postthrombotic syndrome with other complications
I87091	Postthrombotic syndrome with other complications of right lower extremity
I87092	Postthrombotic syndrome with other complications of left lower extremity
I87093	Postthrombotic syndrome with other complications of bilateral lower extremity
I87099	Postthrombotic syndrome with other complications of unspecified lower extremity
O2230	Deep phlebothrombosis in pregnancy, unspecified trimester
O2231	Deep phlebothrombosis in pregnancy, first trimester
O2232	Deep phlebothrombosis in pregnancy, second trimester
O2233	Deep phlebothrombosis in pregnancy, third trimester
O2250	Cerebral venous thrombosis in pregnancy, unspecified trimester
O2251	Cerebral venous thrombosis in pregnancy, first trimester
O2252	Cerebral venous thrombosis in pregnancy, second trimester
O2253	Cerebral venous thrombosis in pregnancy, third trimester
O2291	Venous complication in pregnancy, unspecified, first trimester
O2292	Venous complication in pregnancy, unspecified, first trimester
O2293	Venous complication in pregnancy, unspecified, first trimester
O871	Deep phlebothrombosis in the puerperium
O873	Cerebral venous thrombosis in the puerperium
O879	Venous complication in the puerperium, unspecified
O2290	Venous complication in pregnancy, unspecified, unspecified trimester
Z7901	Long-term (current) use of anticoagulants
Z7902	Long-term (current) use of antithrombotics/antiplatelets
Z86718	Personal history of other venous thrombosis and embolism
Z8672	Personal history of thrombophlebitis
Z8679	Personal history of other diseases of the circulatory system

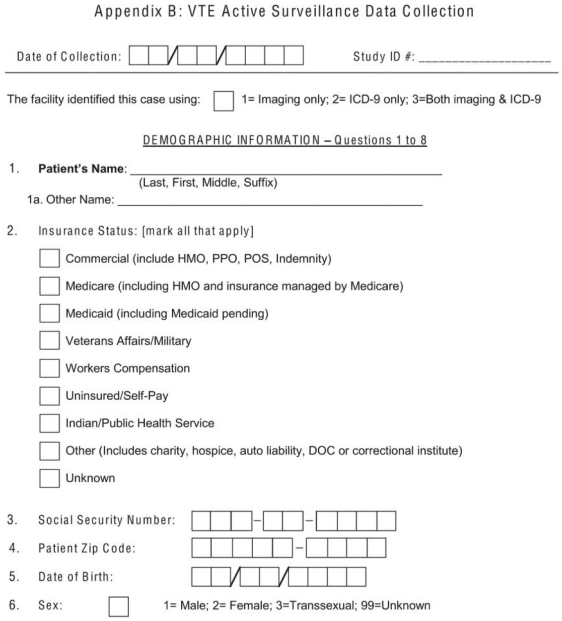
Pulmonary embolism—related ICD-9 codes, CPT codes, and ICD-10 codes

ICD-10 codes	Definition
I26	PE
I260	PE with acute cor pulmonale
I2601	Septic PE with acute cor pulmonale

ICD-10 codes	Definition
I2602	Saddle embolus of pulmonary artery with acute cor pulmonale
I2609	Other PE with acute cor pulmonale
I269	PE without acute cor pulmonale
I2690	Septic PE without acute cor pulmonale
I2692	Saddle embolus of pulmonary artery without acute cor pulmonale
I2699	Other PE without acute cor pulmonale
I82890	Acute embolism and thrombosis of other specified veins
I8291	Chronic embolism an thrombosis of unspecified vein
O032	Embolism after incomplete spontaneous abortion
O037	Embolism after complete or unspecified spontaneous abortion
O047	Embolism after (induced) termination of pregnancy
O072	Embolism after failed attempted termination of pregnancy
O082	Embolism after ectopic and molar pregnancy
O88	Obstetric embolism
O882	Obstetric thromboembolism
O8821	Thromboembolism in pregnancy
O88211	Thromboembolism in pregnancy, first trimester
O88212	Thromboembolism in pregnancy, second trimester
O88213	Thromboembolism in pregnancy, third trimester
O88219	Thromboembolism in pregnancy, unspecified trimester
O8822	Thromboembolism in childbirth
O8823	Thromboembolism in the puerperium
O883	Obstetric pyemic and septic embolism
O8831	Pyemic and septic embolism in pregnancy
O88311	Pyemic and septic embolism in pregnancy, first trimester
O88312	Pyemic and septic embolism in pregnancy, second trimester
O88313	Pyemic and septic embolism in pregnancy, third trimester
O88319	Pyemic and septic embolism in pregnancy, unspecified trimester
O8832	Pyemic and septic embolism in childbirth
O8833	Pyemic and septic embolism in the puerperium
O888	Other obstetric embolism
O8881	Other embolism in pregnancy
O88811	Other embolism in pregnancy, first trimester
O88812	Other embolism in pregnancy, second trimester
O88813	Other embolism in pregnancy, third trimester
O88819	Other embolism in pregnancy, unspecified trimester
O8882	Other embolism in childbirth
O8883	Other embolism in the puerperium
T800XXA	Air embolism after infusion, transfusion, and therapeutic injection, initial encounter
T81718A	Complication of other artery after a procedure, not elsewhere

ICD-10 codes	Definition
	classified, initial encounter
T8172XA	Complication of vein after a procedure, not elsewhere classified, initial encounter
T82817A	Embolism of cardiac prosthetic devices, implants, and grafts, initial encounter
T82818A	Embolismof vascular prosthetic devices, implants, and grafts, initial
Z7901	Long-term (current) use of anticoagulants
Z7902	Long-term (current) use of antithrombotics/antiplatelets
Z86711	Personal history of PE
Z86718	Personal history of other venous thrombosis and embolism
Z8679	Personal history of other diseases of the circulatory system

Appendix B



Appendix B: VTE Active Surveillance Data Collection

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

The facility identified this case using: ☐ 1= Imaging only; 2= ICD-9 only; 3=Both imaging & ICD-9

DEMOGRAPHIC INFORMATION – Questions 1 to 8

1. **Patient's Name**: _____ (Last, First, Middle, Suffix)

1a. Other Name: _____

2. Insurance Status: [mark all that apply]

- ☐ Commercial (include HMO, PPO, POS, Indemnity)
- ☐ Medicare (including HMO and insurance managed by Medicare)
- ☐ Medicaid (including Medicaid pending)
- ☐ Veterans Affairs/Military
- ☐ Workers Compensation
- ☐ Uninsured/Self-Pay
- ☐ Indian/Public Health Service
- ☐ Other (Includes charity, hospice, auto liability, DOC or correctional institute)
- ☐ Unknown

3. Social Security Number: ☐☐☐–☐☐–☐☐☐☐

4. Patient Zip Code: ☐☐☐☐☐–☐☐☐☐

5. Date of Birth: ☐☐/☐☐/☐☐☐☐

6. Sex: ☐ 1= Male; 2= Female; 3=Transsexual; 99=Unknown

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

7. Race and ethnicity: [mark one or more of the following]

- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Hispanic
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ White
- ☐ The patient does not wish to provide some or all of the above racial information
- ☐ Unknown

8. Vital Status: ☐ 1=Alive; 2=Dead; 99=Unknown

8a. Date of death: ☐☐/☐☐/☐☐☐☐

8b. Cause of death: _____

PHYSICIAN/FACILITY INFORMATION – Questions 9 to 13

9. Facility Type where surveillance conducted: ☐ 1=Hospital; 2=Clinic

9a. Name of facility: _____

10. Admitting/Attending Physician: _____

11. Primary Care/Referring Physician: _____

12. Diagnosing Physician: _____

13. Admitted to the hospital? ☐ 1=Yes; 0=No/Unknown

13a. Reason admitted: _____

13b. Date of admission: ☐☐/☐☐/☐☐☐☐

13c. Date of discharge: ☐☐/☐☐/☐☐☐☐

Data Collector's Initials ☐ NF ☐ JA ☐ AS

v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

DVT DIAGNOSTIC INFORMATION – Questions 14 to 17

14. Diagnosed with DVT? ☐ 1=Yes; 0=No/Unknown

14a. Date of DVT diagnosis: ☐☐/☐☐/☐☐☐☐

14b. Vein in which thrombus found? [Mark all that apply]

1=posterior tibial; 2=anterior tibial; 3=peroneal; 4=soleal; 5=gastrocnemius 6=popliteal; 7=femoral; 8=internal iliac; 9=external iliac; 10=inferior vena cava; 11=brachial; 12=axillary; 13=subclavian; 14=innominate; 15=superior vena cava; 16=jugular; 99=unknown

Vein 1:	☐	Location 1:	☐	1=right, 2=left, 3=bilateral, 99=unknown
Vein 2:	☐	Location 2:	☐	1=right, 2=left, 3=bilateral, 99=unknown
Vein 3:	☐	Location 3:	☐	1=right, 2=left, 3=bilateral, 99=unknown
Vein 4:	☐	Location 4:	☐	1=right, 2=left, 3=bilateral, 99=unknown
Vein 5:	☐	Location 5:	☐	1=right, 2=left, 3=bilateral, 99=unknown
Vein 6:	☐	Location 6:	☐	1=right, 2=left, 3=bilateral, 99=unknown

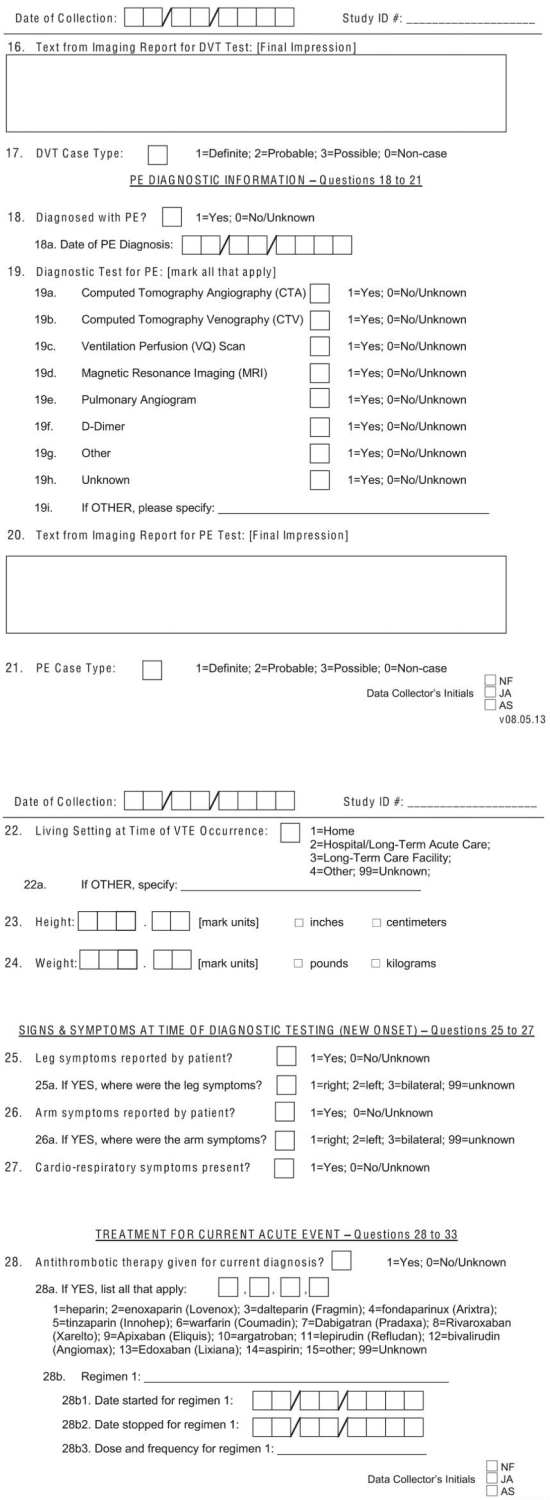
15. Diagnostic Test for DVT: [mark all that apply]

15a.	Compression Ultrasound	☐	1=Yes; 0=No/Unknown
15b.	Computed Tomography Venography (CTV)	☐	1=Yes; 0=No/Unknown
15c.	Magnetic Resonance Imaging (MRI)	☐	1=Yes; 0=No/Unknown
15d.	Traditional Contrast Venography	☐	1=Yes; 0=No/Unknown
15e.	D-Dimer	☐	1=Yes; 0=No/Unknown
15f.	Other	☐	1=Yes; 0=No/Unknown
15g.	Unknown	☐	1=Yes; 0=No/Unknown

15h. If OTHER, please specify: _____

Data Collector's Initials ☐ NF ☐ JA ☐ AS

v08.05.13



Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

16. Text from Imaging Report for DVT Test: [Final Impression]

17. DVT Case Type: ☐ 1=Definite; 2=Probable; 3=Possible; 0=Non-case

PE DIAGNOSTIC INFORMATION – Questions 18 to 21

18. Diagnosed with PE? ☐ 1=Yes; 0=No/Unknown

18a. Date of PE Diagnosis: ☐☐/☐☐/☐☐☐☐

19. Diagnostic Test for PE: [mark all that apply]

19a.	Computed Tomography Angiography (CTA)	☐	1=Yes; 0=No/Unknown
19b.	Computed Tomography Venography (CTV)	☐	1=Yes; 0=No/Unknown
19c.	Ventilation Perfusion (VQ) Scan	☐	1=Yes; 0=No/Unknown
19d.	Magnetic Resonance Imaging (MRI)	☐	1=Yes; 0=No/Unknown
19e.	Pulmonary Angiogram	☐	1=Yes; 0=No/Unknown
19f.	D-Dimer	☐	1=Yes; 0=No/Unknown
19g.	Other	☐	1=Yes; 0=No/Unknown
19h.	Unknown	☐	1=Yes; 0=No/Unknown

19i. If OTHER, please specify: _____

20. Text from Imaging Report for PE Test: [Final Impression]

21. PE Case Type: ☐ 1=Definite; 2=Probable; 3=Possible; 0=Non-case

Data Collector's Initials ☐ NF ☐ JA ☐ AS

v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

22. Living Setting at Time of VTE Occurrence: ☐ 1=Home 2=Hospital/Long-Term Acute Care; 3=Long-Term Care Facility; 4=Other; 99=Unknown;

22a. If OTHER, specify: _____

23. Height: ☐☐☐.☐☐ [mark units] ☐ inches ☐ centimeters

24. Weight: ☐☐☐.☐☐ [mark units] ☐ pounds ☐ kilograms

SIGNS & SYMPTOMS AT TIME OF DIAGNOSTIC TESTING (NEW ONSET) – Questions 25 to 27

25.	Leg symptoms reported by patient?	☐	1=Yes; 0=No/Unknown
	25a. If YES, where were the leg symptoms?	☐	1=right; 2=left; 3=bilateral; 99=unknown
26.	Arm symptoms reported by patient?	☐	1=Yes; 0=No/Unknown
	26a. If YES, where were the arm symptoms?	☐	1=right; 2=left; 3=bilateral; 99=unknown
27.	Cardio-respiratory symptoms present?	☐	1=Yes; 0=No/Unknown

TREATMENT FOR CURRENT ACUTE EVENT – Questions 28 to 33

28. Antithrombotic therapy given for current diagnosis? ☐ 1=Yes; 0=No/Unknown

28a. If YES, list all that apply: ☐,☐,☐,☐

1=heparin; 2=enoxaparin (Lovenox); 3=dalteparin (Fragmin); 4=fondaparinux (Arixtra); 5=tinzaparin (Innohep); 6=warfarin (Coumadin); 7=Dabigatran (Pradaxa); 8=Rivaroxaban (Xarelto); 9=Apixaban (Eliquis); 10=argatroban; 11=lepirudin (Refludan); 12=bivalirudin (Angiomax); 13=Edoxaban (Lixiana); 14=aspirin; 15=other; 99=Unknown

28b. Regimen 1: _____

28b1. Date started for regimen 1: ☐☐/☐☐/☐☐☐☐

28b2. Date stopped for regimen 1: ☐☐/☐☐/☐☐☐☐

28b3. Dose and frequency for regimen 1: _____

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v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

28c. Regimen 2: _____

28c1. Date started for regimen 2: ☐☐/☐☐/☐☐☐☐

28c2. Date stopped for regimen 2: ☐☐/☐☐/☐☐☐☐

28c3. Dose and frequency for regimen 2: _____

28d. Regimen 3: _____

28d1. Date started for regimen 3: ☐☐/☐☐/☐☐☐☐

28d2. Date stopped for regimen 3: ☐☐/☐☐/☐☐☐☐

28d3. Dose and frequency for regimen 3: _____

28e. Regimen 4: _____

28e1. Date started for regimen 4: ☐☐/☐☐/☐☐☐☐

28e2. Date stopped for regimen 4: ☐☐/☐☐/☐☐☐☐

28e3. Dose and frequency for regimen 4: _____

29. Thrombolysis given for current diagnosis? ☐ 1=Yes; 0=No/Unknown

29a. If YES, list all that apply: ☐, ☐

1=alteplase (Activase, Cathflo Activase, tissue plasminogen activator, TPA); 2=reteplase (Retevase); 3=Streptokinase (Streptase); 4=tenecteplase (TNKase); 5=Urokinase (Abbokinase); 6=Other; 99=Unknown

29b. Regimen 1: _____

29b1. Date started for regimen 1: ☐☐/☐☐/☐☐☐☐

29b2. Method delivered for regimen 1: ☐ 1=catheter-directed; 2=systemic; 99=Unknown

29c. Regimen 2: _____

29c1. Date started for regimen 2: ☐☐/☐☐/☐☐☐☐

29c2. Method delivered for regimen 2: ☐ 1=catheter-directed; 2=systemic; 99=unknown

Data Collector's Initials ☐ NF ☐ JA ☐ AS

v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

30. IVC filter placed for current diagnosis? ☐ 1=Yes; 0=No/Unknown

30a. Date IVC placed: ☐☐/☐☐/☐☐☐☐

31. Venous Thrombectomy for current diagnosis? ☐ 1=Yes; 0=No/unknown

31a. Date of procedure: ☐☐/☐☐/☐☐☐☐

31b. If yes, was thrombus confirmed? ☐ 1=Yes; 0=No/Unknown

32. Pulmonary Embolectomy for current diagnosis? ☐ 1=Yes; 0=No/Unknown

32a. Date of procedure: ☐☐/☐☐/☐☐☐☐

32b. If YES, was PE confirmed? ☐ 1=Yes; 0=No/Unknown

33. Compression stockings prescribed for current diagnosis?

☐ 1=Yes; 0=No/unknown

PROPHYLAXIS FOR CURRENT ACUTE EVENT – Questions 34 to 37

34. Was patient on anticoagulant prophylaxis at time of current diagnosis?

☐ 1=Yes; 0=No/Unknown

34a. If YES, type of anticoagulant used? _____

34a1. Dose: _____

34a2. Frequency: _____

34a3. Date started: ☐☐/☐☐/☐☐☐☐

35. Was patient taking anticoagulants during the past 12 months? ☐ 1=Yes; 0=No/Unknown

35a. If YES, reason for use: ☐ 1=Prior VTE; 2=Atrial fib; 3=Other; 99=Unknown

35a1. Type of anticoagulant used? _____

Data Collector's Initials ☐ NF ☐ JA ☐ AS

v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

35a2. Dose: _____

35a3. Frequency: _____

35a4. Date started: ☐☐/☐☐/☐☐☐☐

35a5. Still taking anticoagulants? ☐ 1=Yes; 0=No/Unknown

36. Was the patient on aspirin at the time of the event? ☐ 1=Yes; 0=No/ Unknown

36a. If YES, reason for use: ☐ 1=CVD prevention; 2=Prior VTE; 3=Other; 99=Unknown

37. Was the patient prescribed or treated with a mechanical device before the event? ☐ 1=Yes; 0=No/Unknown

37a. If YES, mark all that applies:

- ☐ Foot pump
- ☐ Anti-embolic compression stockings
- ☐ Intermittent pneumatic compression device
- ☐ Unknown
- ☐ None

PREVIOUS VTE EVENTS & TREATMENT AND PROPHYLAXIS FOR PREVIOUS VTE EVENTS – Questions 38 to 40

38. Does patient have past history of DVT? ☐ 1=Yes; 0=No/Unknown

38a.If YES, documented by: ☐ 1=Clinical Only; 2=Venogram; 3=CUS; 4=Other; 5=Self report; 99=Unknown

38b. Number of previous episodes of DVT (before this one): ☐

38c. Date of first DVT diagnosis: ☐☐/☐☐/☐☐☐☐

38d. Date of DVT diagnosis immediately preceding current event: ☐☐/☐☐/☐☐☐☐

39. Does patient have past history of PE? ☐ 1=Yes; 0=No/Unknown

39a. If YES, documented by: ☐ 1=Clinical Only; 2=CTA; 3= VQ Scan; 4=MRI; 5=Self Report; 99=Unknown

39b. Number of previous episodes of PE? ☐

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Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

39c. Date of first PE diagnosis: ☐☐/☐☐/☐☐☐☐

39d. Date of PE diagnosis immediately preceding current event: ☐☐/☐☐/☐☐☐☐

40. Does the patient have a history of IVC filter placement? ☐ =Yes; 0=No/ Unknown

40a. If YES, is filter currently in place? ☐ 1=Yes; 0=No/Unknown

RISK FACTORS – Questions 41 to 59

41. Known Thrombophilic or Prothrombotic Condition? ☐ 1=Yes; 0=No/Unknown

41a. If YES, mark all that applies:

- ☐ Antiphospholipid antibody syndrome
- ☐ Factor V Leiden
- ☐ APC Resistance (No gene testing)
- ☐ Prothrombin 20210
- ☐ Protein C deficiency
- ☐ Protein S deficiency
- ☐ DIC (disseminated intravascular coagulation)
- ☐ Antithrombin deficiency
- ☐ Sickle cell disease
- ☐ Thalassemia
- ☐ Inflammatory Bowel Disease
- ☐ Systemic Lupus Erythematosus
- ☐ Family History (VTE)
- ☐ Other

41b. If OTHER, please specify: _____

42. During the last three months, did the patient have a diagnosis of Heparin Induced Thrombocytopenia with/without thrombosis (HIT/T) ☐ 1=Yes; 0= No/Unknown

43. Does the patient have a history of cancer (except basal or squamous cell of the skin)? ☐ 1=Yes; 0=No/Unknown

43a. If YES, diagnosis date: ☐☐/☐☐/☐☐☐☐

43b. If YES, Diagnosing Facility: _____

43c. If YES, Cancer type [primary location]: _____

43d. If YES, is cancer metastatic? ☐ 1=Yes; 0=No/Unknown

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Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

44. Hospitalization in the past 12 months? ☐ 1=Yes; 0=No/Unknown
List starting with most recent:
44a. Reason for hospitalization 1: _____
44a1. Date of admission 1: ☐☐/☐☐/☐☐☐☐
44a2. Date of discharge 1: ☐☐/☐☐/☐☐☐☐
44b. Reason for hospitalization 2: _____
44b1. Date of admission 2: ☐☐/☐☐/☐☐☐☐
44b2. Date of discharge 2: ☐☐/☐☐/☐☐☐☐

45. Trauma in the past 12 months? ☐ 1=Yes; 0=No/Unknown
45a. If YES, type of Trauma: _____
45b. If YES, date of Trauma: ☐☐/☐☐/☐☐☐☐

46. Surgery in the past 12 months? ☐ 1=Yes; 0=No/Unknown
List starting with most recent:
46a1. Indicate area of surgery 1: ☐ 1=Hip; 2=Knee; 3= Pelvic; 4=Abdominal; 5=Thoracic; 6=Cardiac; 7=Neurosurgery; 8=Other; 99=Unknown
46a2. If OTHER, specify: _____
46a3. Date of surgery 1: ☐☐/☐☐/☐☐☐☐
46a4. Indicate invasiveness of surgery 1: [mark all that apply]
☐ Laparoscopic ☐ Conventional ☐ Arthroscopic
☐ Robotic ☐ Other ☐ Unknown
46a5. If OTHER, please specify: _____
46b1. Indicate area of surgery 2: ☐ 1=Hip; 2=Knee; 3= Pelvic; 4=Abdominal; 5=Thoracic; 6=Cardiac; 7=Neurosurgery; 8=Other; 99=Unknown
46b2. If OTHER, specify: _____
☐☐/☐☐/☐☐☐☐ Data Collector's Initials ☐ NF ☐ JA ☐ AS
v08.05.13

Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

46b3. Date of surgery 2:
46b4. Indicate invasiveness of surgery 2: [mark all that apply]
☐ Laparoscopic ☐ Arthroscopic ☐ Unknown
☐ Robotic ☐ Conventional (Open) surgery ☐ Other
46b5. If OTHER, please specify: _____

47. Paralysis of the leg? ☐ 1=Yes, but Location Unknown; 2=Right; 3=Left; 4=Bilateral; 0=No/Unknown
47a. If YES, date of onset: ☐☐/☐☐/☐☐☐☐
47b. If YES, is paralysis currently present? ☐ 1=Yes; 0=No/Unknown

48. History of congestive heart failure? ☐ 1=Yes; 0=No/Unknown
48a. If YES, diagnosis date: ☐☐/☐☐/☐☐☐☐

49. History of stroke? ☐ 1=Yes; 0=No/Unknown
49a. If YES, diagnosis date: ☐☐/☐☐/☐☐☐☐
49b. If YES, diagnosis date uncertain, but was:
☐ 1=Less than 3 months ago; 2=3 to <6 months ago; 3=6 to <12 months ago; 4=12 or more months ago; 99=Unknown
49c. If YES, type of stroke: ☐ 1=Ischemic; 2= Hemorrhagic; 99=Unknown

50. History of myocardial infarction? ☐ 1=Yes; 0=No/Unknown
50a. If YES, diagnosis date of most recent event: ☐☐/☐☐/☐☐☐☐
50b. If YES, diagnosis date uncertain, but was:
☐ 1=Less than 3 months ago; 2=3 to <6 months ago; 3=6 to <12 months ago; 4=12 or more months ago; 99=Unknown

51. History of varicose veins? ☐ 1=Yes, but Location Unknown; 2=Right; 3=left; 4=Bilateral; 0=No/Unknown
☐☐/☐☐/☐☐☐☐ Data Collector's Initials ☐ NF ☐ JA ☐ AS
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Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

51a. If YES, diagnosis date:

52. Does the patient have a past history of superficial vein thrombosis?

☐ 1=Yes; 0=No/Unknown

53. Immobilized (3+ consecutive days in bed) in the past 3 months?

☐ 1=Yes; 0=No/Unknown

54. Central venous catheterization in the past 6 months?

☐ 1=Yes, Location Unknown; 2=Right Arm; 3=Left Arm; 4=Right Femoral; 5=Left Femoral; 6=other; 0=No/Unknown

54a. If YES, date most recent was inserted: ☐☐/☐☐/☐☐☐☐

54b. If YES, date removed: ☐☐/☐☐/☐☐☐☐

54c. If YES, does patient currently have central venous catheter? ☐ 1=Yes; 0=No/Unknown

55. Pregnancy in past 6 months or currently pregnant? ☐ 1=Yes; 0=No/Unknown

55a. If YES, date (or expected date) of delivery: ☐☐/☐☐/☐☐☐☐

55b. If YES, date of Loss: ☐☐/☐☐/☐☐☐☐

56. Consecutive duration travel by ground or air within the previous 3 months?

☐ 1=Yes; 0=No/Unknown

List starting with most recent:

56a. If YES, method of Travel 1: ☐ 1=Air; 2=Ground; 99=Unknown

56a1. Duration of travel 1: ☐ 1= 4 to <8hrs; 2=8 to <12hrs; 3=≥12 hrs; 99=Unknown

56a2. Date and circumstances of travel 1: _____

_____

56b. If YES, method of Travel 2: ☐ 1=Air; 2=Ground; 99=Unknown

56b1. Duration of travel 2: ☐ 1= 4 to <8hrs; 2=8 to <12hrs; 3=≥12 hrs; 99=Unknown

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Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

56b2. Date and circumstances of travel 2: _____

_____

57. Does the patient have a history of using any of the following medications within the past 12 months?

☐ 1=Yes; 0=No/Unknown

57a. If YES, mark all that applies:	Date stopped	Currently Taking?
☐ Estrogen containing	☐☐/☐☐/☐☐☐☐	☐
☐ Progesterone containing	☐☐/☐☐/☐☐☐☐	☐
☐ Combination	☐☐/☐☐/☐☐☐☐	☐
☐ Tamoxifen (Tamoxifen)	☐☐/☐☐/☐☐☐☐	☐
☐ Raloxifene (Evista)	☐☐/☐☐/☐☐☐☐	☐
☐ Corticosteroids	☐☐/☐☐/☐☐☐☐	☐
☐ Other	☐☐/☐☐/☐☐☐☐	☐

57b. If OTHER, please specify: _____

58. Does the patient have a history of using any of the following medications?

☐ 1=Yes; 0=No/Unknown

58a. If YES, mark all that applies:

☐ Erythropoietin (Epogen, epoetin, Procrit) ☐ Thalidomide (Thalomid)

☐ Romiplostim (Nplate) ☐ Revlimid (Lenalidomide)

☐ Oprelvekin (Neumega) ☐ Other

☐ Eltrobopaq (Promacta)

58b. If OTHER, please specify: _____

58c. Still taking medication(s)? ☐ 1=Yes; 0=No/Unknown

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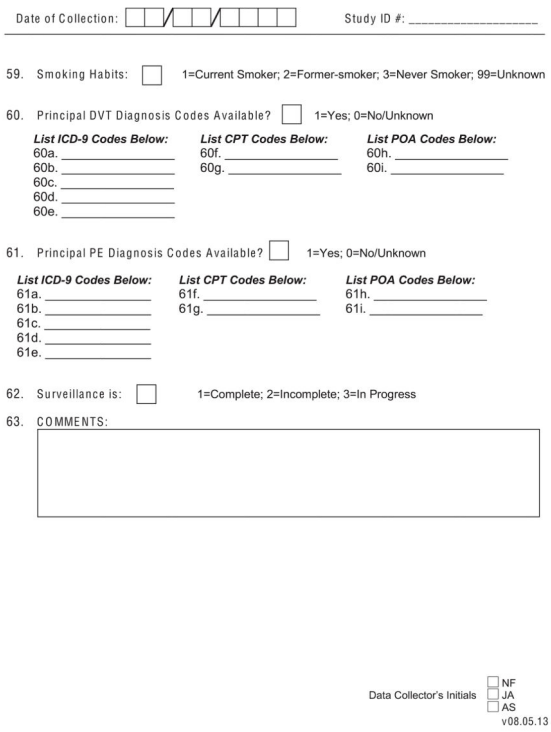
Date of Collection: ☐☐/☐☐/☐☐☐☐ Study ID #: _____

59. Smoking Habits: ☐ 1=Current Smoker; 2=Former-smoker; 3=Never Smoker; 99=Unknown

60. Principal DVT Diagnosis Codes Available? ☐ 1=Yes; 0=No/Unknown

List ICD-9 Codes Below:	List CPT Codes Below:	List POA Codes Below:
60a. _____	60f. _____	60h. _____
60b. _____	60g. _____	60i. _____
60c. _____		
60d. _____		
60e. _____		

61. Principal PE Diagnosis Codes Available? ☐ 1=Yes; 0=No/Unknown

List ICD-9 Codes Below:	List CPT Codes Below:	List POA Codes Below:
61a. _____	61f. _____	61h. _____
61b. _____	61g. _____	61i. _____
61c. _____		
61d. _____		
61e. _____		

62. Surveillance is: ☐ 1=Complete; 2=Incomplete; 3=In Progress

63. COMMENTS:

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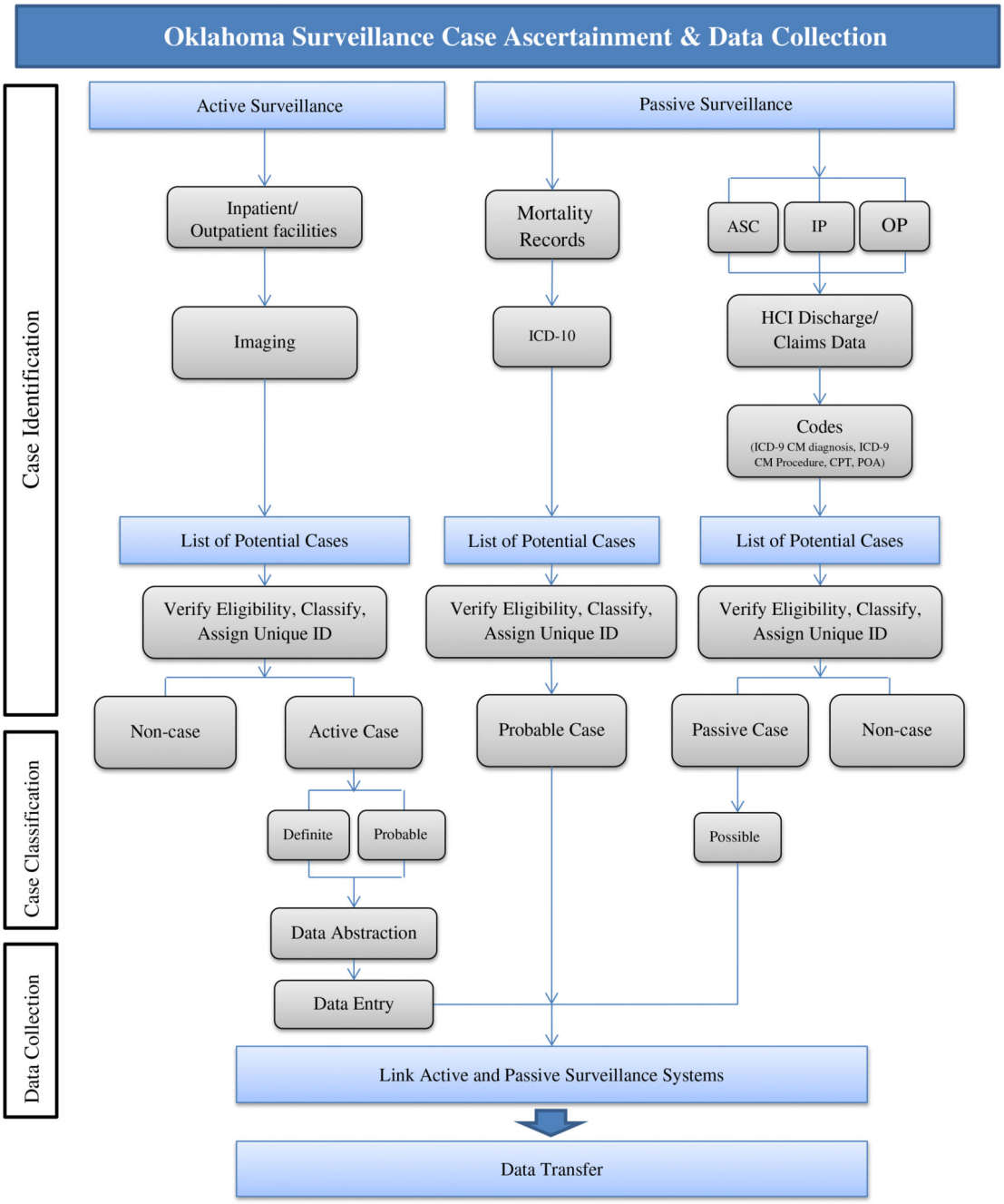

Figure.

Flowchart for surveillance system for VTE in Oklahoma County, OK—April 1, 2012 to March 31, 2014. Abbreviations: ASC, ambulatory surgical centers; IP, inpatient; OP, outpatient; HCI, health care information; ID, identification.

Table I

Objectives for the VTE surveillance system using combined active and passive methods

Objectives	
1	Develop and implement a pilot, population-based surveillance system for DVT and PE in Oklahoma County, OK, that includes both active and passive surveillance activities and which can accurately capture outpatient, inpatient, and death-related VTE events and distinguish first episode (incident) from recurrent VTE events;
2	Estimate the annual incidence of first-episode VTE events and of the components of DVT and PE separately;
3	Estimate the annual incidence of recurrent VTE events and of the components of DVT and PE;
4	Estimate the 30-day, 90-day, and 6-month mortality associated with a diagnosis of VTE and the component events of DVT and PE;
5	Describe the above VTE disease burden indicators by age, gender, and race/ethnicity, including the minority groups of American Indian, Black, Hispanic, and Asian;
6	Collect data on risk factors associated with documented VTE events;
7	Identify hypotheses for future research to reduce the burden of VTE disease.

Table II

Racial, ethnic, gender, and income distribution of the population in the United States, Oklahoma State, and Oklahoma County, 2012[11]

	United States		Oklahoma County	
Race/ethnicity	**n**	**%**	**n**	**%**
Population	313,914,040	100	741,781	100
Race				
White	239,645,013	76.3	553,227	74.6
Black	43,140,238	13.7	127,854	17.2
American Indian	5,226,034	1.7	57,462	7.7
Asian	18,326,450	5.8	28,223	3.8
Hawaiian/Pacific Islander	1,250,274	0.4	1,500	0.2
Other	16,232,503	5.2	26,956	3.6
Ethnicity				
Hispanic	52,961,017	16.9	116,932	15.8
Non-Hispanic	260,953,023	83.1	624,849	84.2
Gender				
Male	154,436,243	49.2	363,306	49.0
Female	159,477,797	50.8	378,475	51.0
Median income (dollars)	53,046		45,082	

Table III

Inpatient and outpatient facility inclusion criteria

		Inpatient and outpatient
Inclusion criteria	**1**	Located within Oklahoma County
	2	Licensed for the following diagnostic equipment: CT, MRI, V/Q scan, contrast venography, or ultrasound.
	3	At least 1 licensed radiologist on staff to diagnose VTE conditions using defined diagnostic equipment.
	4	Licensed health care provider in specialty at any level from December 2012 National Provider Identification listing from radiology (neuroradiology, nuclear radiology, radiation oncology, diagnostic radiology, diagnostic ultrasound, surgery, surgical critical care, vascular surgery, urology, pediatric urology, and thoracic surgery), allopathic and osteopathic physicians (general practice, pulmonary disease, interventional cardiology, hematology and oncology, clinical cardiac electrophysiology, internal medicine, family medicine, and independent medical examiner), pathology hematology, and podiatric medicine and surgery service providers.
Exclusion criteria	**1**	If licensed diagnostic equipment is too old to currently diagnose VTE conditions.
	2	If patient volume with a VTE condition was <5 patients per year

Table IV

Case definitions for DVT and PE

	DVT	PE
Definite	**a.** Imaging is confirmatory or **b.** Autopsy or **c.** Venous thrombectomy confirms thrombus is present	**a.** Imaging is confirmatory or **b.** Autopsy or **c.** Pulmonary embolectomy confirms embolism is present
Probable	**a.** Imaging is indeterminate, and review of records shows mention of DVT or suspected DVT and treatment given: **1)** Anticoagulant or **2)** DVT-related procedure: vena cava filter or thrombolysis (systemic or catheter directed)	**a.** Imaging is indeterminate or not available/not done, and review of records shows mention of PE or suspected PE and treatment given: **1)** Anticoagulant or **2)** PE-related procedure: vena cava filter or thrombolysis (systemic or catheter directed) or **b.** Death certificate—contributing cause of death
Possible: ≥2 of the following:	**a.** *ICD-9 CM* code or **b.** DVT related CPT code or **c.** *ICD-10 CM* code or **d.** POA indicator listed as “Y” for DVT	**a.** *ICD-9 CM* code or **b.** PE-related CPT code or **c.** *ICD-10 CM* code or **d.** POA code indicator listed as “Y” for PE

Table V

The distribution of case patients for each stage of surveillance stratified by facility type

	Identified patients with diagnostic procedure		Screened records		Patients meeting case definition		Case patients with data collection complete	
Facility type	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Inpatient facilities	50,535	92.2	50,466	92.6	2496	91.6	2059	92.3
Outpatient facilities	4247	7.8	4028	7.4	229	8.4	172	7.7
Total	54,782	100	54,494	100	2725	100	2231	100

Table VI

The distribution of case patients stratified by facility type and disease manifestation

	Inpatient facilities		Outpatient facilities		Total	
Disease manifestation	**n**	**%**	**n**	**%**	**n**	**%**
VTE cases	2059	100	172	100	2231	100
DVT only	1290	62.7	156	90.7	1446	64.8
PE only	476	23.1	11	6.4	487	21.8
Both DVT and PE	293	14.2	5	2.9	298	13.4